ME-2339

613

Beckman

Operating and Servicing Manual

Electronic Instruments Division

C.1

BII No. 015-436087

LOT ____

SERIAL NO. _____

MODEL 613

Heterodyne Converter
(3 to 12.4 GHz)

(PREFIX 500)

69-04-17-12

NOTE

Early models of the 6120, 6121, 6126, 6127, 6145, 6146, and 6147 Counters must be modified to operate with the Model 613. Refer to the individual counter manual, 1-10 MHz Multiplier Board diagram, to determine the assembly number of the Multiplier. Any Multiplier assembly number other than "C431025" is not useable with the Model 613 Plug-In.

Contact your nearest field service representative for further information.

Beckman
INSTRUMENTS, INC.

ELECTRONIC INSTRUMENTS DIVISION
RICHMOND, CALIFORNIA • 94804

FEBRUARY 1969

©1969 BECKMAN INSTRUMENTS, INC.

MODEL 613

Addendum A

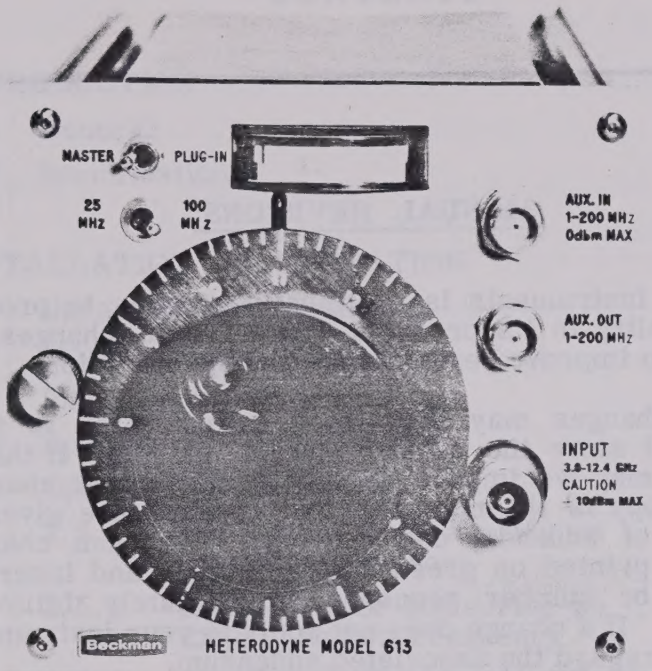
Please note that the following instruments may require rewiring to accommodate the Model 613:

Model 6126, Beckman Part No. 82-413652, or prior to Serial No. 171.
Model 6127, Beckman Part No. 82-418458, or prior to Serial No. 120.
Model 6146, Beckman Part No. 82-413030, or prior to Serial No. 434.
Model 6147, Beckman Part No. 82-416892, or prior to Serial No. 159.

Proceed as follows:

- add two wires to J7, one from pin 45 to XA28 pin M (Control Board) and one from pin 47 to XA28 pin N.

(3-69)



Model 613 Heterodyne Converter
(3 to 12.4 GHz)

- Frontispiece -

MANUAL REVISIONS

Beckman Instruments is continually striving to provide better quality in its products. As a result, changes are initiated to improve performance and specifications.

Several changes may have been incorporated in your instrument since the manual was last printed. If this is the case, may we impose on you to make these changes to your copy of the manual? All changes are given in the form of addenda, one addendum for each change. They are printed on green-colored paper and inserted, in letter or number sequence, immediately following this page. If a change does not apply to your instrument, please disregard the associated addendum.

PREFIX NUMBERS

The prefix number denotes a generation of manuals. All addenda for a certain prefix number are incorporated in the manual before reprinting and the number increased by one (e.g., "Prefix 500" becomes "Prefix 501").

CONTENTS

			Page
SEC. 1	INTRODUCTION		
	1.1	General	1-1
	1.2	Specifications	1-1
SEC. 2	INSTALLATION and OPERATION		
	2.1	Unpacking and Handling	2-1
	2.2	Storage and Reshipment	2-1
	2.3	Installation	2-1
	2.4	Applying Power	2-2
	2.5	Operation	2-2
		2.5.1 Procedure for Measuring an Unknown Frequency	2-2
		2.5.2 Procedure for Measuring an Exactly Known Frequency	2-3
		2.5.3 Avoiding Confusion when Using Heterodyne Frequency Converters	2-3
SEC. 3	THEORY OF OPERATION		
	3.1	Basic Theory of Operation	3-1
	3.2	General Functional Description	3-1
		3.2.1 200 MHz Generator	3-1
		3.2.2 Harmonic Generator	3-3
		3.2.3 Video Amplifier	3-3
		3.2.4 Frequency Prescaler	3-5
		3.2.5 Time Base Divider Circuit	3-6
SEC. 4	MAINTENANCE		
	4.1	General	4-1
SEC. 5	DIAGRAMS and PARTS LISTS		
	5.1	General	5-1

continued. . .

	Dwg. No.	Page
Model 613 Block Diagram	C436835	5-2
Mechanical & Wired Assembly Diagram	D436911	5-3
Mechanical & Wired Assembly Parts List		5-4
Comb Generator P.C. Board Diagram	A550084	5-5
Microwave Assembly Parts List with Mixer Cavity and Comb Generator		5-6
Microwave Assembly Schematic Diagram	B550081	5-7
Video Amplifier P.C. Board Assembly Diagram	B436850	5-8
Video Amplifier P.C. Board Assembly Parts List		5-9
Video Amplifier Schematic Diagram	D436849	5-12
Master Board P.C. Assembly Diagram	C436860	5-13
Master Board P.C. Assembly Parts List		5-14
Master Board Schematic Diagram (Page 1 of 2)	D436859	5-19
Master Board Schematic Diagram (Page 2 of 2)	D436859	5-20

ILLUSTRATIONS

Figure		
3-1	Model 613 Block Diagram	3-2
3-2	200 MHz Generator Functional Block Diagram	3-3
3-3	Video Amplifier Functional Block Diagram	3-4
3-4	Frequency Prescaler Functional Block Diagram	3-5
3-5	Time Base Divider Functional Block Diagram	3-7

TABLES

Table		
1-1	Specifications	1-1
5-1	Diagrams and Parts Lists	5-1

SECTION 1
INTRODUCTION

1.1 GENERAL

The Model 613 Heterodyne Converter Plug-In Unit extends the range of the Beckman 25, 50, or 100 MHz basic counter to 3 - 12.4 GHz.

1.2 SPECIFICATIONS

Table 1-1 gives the specifications of the Model 613.

Table 1-1. Specifications

Accuracy	Maintains accuracy of basic instrument.
Range	As a converter: 3 GHz to 12.4 GHz. As a prescaler: 1 MHz to 200 MHz.
Input Characteristics	(a) Sensitivity: As a converter, 100 mV (-7 dBm) to 0.7 V (+10 dBm); as a prescaler, 5 mV (-33 dBm) to 0.22 V (0 dBm). (b) Impedance: 50Ω nominal. (c) Maximum Input Overload: 0.7 V rms (+10 dBm) as a converter or prescaler. (d) Input Coupling: dc (high frequency input); ac (prescaler input).
Indication	Reference frequency dial calibrated in 200 MHz increments from 2.8 GHz to 12.6 GHz; digital display of basic instrument is added to reference frequency on dial; display of basic instrument includes unit of measurement and automatically-positioned decimal point.
Meter	Tuning meter indicates usable signal level and aids frequency selection.

continued. . .

Table 1-1. Specifications - continued

Input Connector	Type N (female).
Power	Supplied by basic instrument
Shipping Weight	12 pounds (5.5 Kg).
6100 Series Instruments Compatibility	Works with Models 6120, 6121, 6126, 6127, 6145, 6146, 6147, 6148, and 6155.
Option A	Increases sensitivity to 70 mV (-10 dBm).

SECTION 2

INSTALLATION AND OPERATION

2.1 UNPACKING and HANDLING

The Model 613 is thoroughly tested and inspected, then carefully packed before shipment. The unit should be unpacked with the care due any precision instrument. If the packing case shows signs of damage, make a note of this on the freight receipt.

Before a unit is used, check it carefully for possible damage. On removal from the shipping container, inspect for dents, scratches, broken or damaged knobs. Should the plug-in be damaged, notify both Beckman Instruments, Inc. and the carrier immediately and retain the original packaging for inspection.

2.2 STORAGE and RESHIPMENT

If it is necessary to return the plug-in to the factory, use the original packaging in which the unit was shipped. Should new packaging be required, use a strong carton (350 lbs./sq. inch bursting strength), wrap the plug-in in heavy paper or covering material, and when it has been placed in the box, use an adequate amount of packing material around the sides. The carton should then be sealed with strong tape or metal banding and should be marked: "HANDLE WITH CARE – DELICATE ELECTRONIC INSTRUMENTATION".

Avoid storing the unit in extreme conditions of temperature or humidity (beyond the range of $-40^{\circ}C$ to $+70^{\circ}C$).

2.3 INSTALLATION

The Model 613 plug-in can be obtained separately, or factory installed in the master instrument. If it is obtained separately, follow these steps for installation.

1) Remove any other installed plug-in as follows:

    a) Turn the securing rod counterclockwise until the plug-in is free to slide forward (securing rod is located on the left side of the plug-in).

b) Pull out the plug-in.

2) Slide the Model 613 into the master instrument. Guide pins at the rear of the Model 613 assure that the connectors mate properly.

3) Tighten the securing rod; this will enable the plug-in to fit flush with the instrument's front panel.

2.4 APPLYING POWER

The master instrument supplies all necessary power to Model 613 via the mating connectors at the rear of the plug-in.

2.5 OPERATION

2.5.1 Procedure for Measuring an Unknown Frequency

1) Install the plug-in in the master instrument. Set the MODE switch on the plug-in unit to the PLUG-IN position.

2) Set the master counter controls for EPUT or FREQ. X measurement with the desired time base.

3) Set the REFERENCE dial below 2.8 GHz.

4) Apply an input frequency between 2.8 and 12.4 GHz, at a level between -7 and +10 dBm.

5) Rotate the REFERENCE control knob slowly in the direction of increasing reference frequency until a LEVEL meter deflection in the green portion of the meter face is obtained. Peak the LEVEL meter deflection.

NOTE

For more accurate tuning, observe the AUX OUT jack on an oscilloscope. The actual video signal is provided.

6) If the counter reading is 201 MHz or less, add it to the REFERENCE dial reading to obtain the input frequency.

7) If the counter reading is greater than 210 MHz, continue advancing the REFERENCE control until a second meter deflection is obtained. Peak the LEVEL meter deflection. The input frequency is now obtained by addition as in step 6).

2.5.2 Procedure for Measuring an Exactly Known Frequency

1) If the frequency of a signal in the range described in paragraph 2.5.1, step 4), is exactly known, set the REFERENCE dial to a reference frequency which lies from 1 to 201 MHz below the signal frequency.

2) Peak the LEVEL meter reading with the REFERENCE control and add the counter reading to the reference frequency to obtain the desired frequency indication (be sure to set controls as described in paragraph 2.5.1, steps 1 and 2).

2.5.3 Avoiding Confusion when Using Heterodyne Frequency Converters

The basic condition to be observed is to exactly follow the operating procedure outlined above. In the interest of better understanding, a feature of heterodyne units which could result in confusion is discussed below.

2.5.3.1 Multiple Beat Frequencies Obtainable

When using the heterodyne unit, the operator will notice that it is always possible to obtain two, and sometimes three, separate meter responses by tuning the REFERENCE control. In general, these multiple beats arise when more than one difference frequency lies in the video amplifier range of 1 - 201 MHz. Also, it should be noted that the actual video bandpass will extend beyond the 1 - 201 MHz range, but the instrument should be used in accordance with the operating procedure so the video frequency falls within these limits.

SECTION 3

THEORY OF OPERATION

3.1 BASIC THEORY OF OPERATION

Operation of the Model 613 Heterodyne Converter Unit is based upon the basic heterodyne technique. A known frequency lower than the input frequency is selected and mixed with the input frequency. The resultant difference frequency is then measured with a digital counter. When the frequency measured with the counter is added to the known frequency, the resultant is the exact input frequency.

3.2 GENERAL FUNCTIONAL DESCRIPTION

Figure 3-1 is a functional block diagram of the Model 613. The basic frequency used in harmonic generation is 200 MHz. To use the unit with 100 MHz and 25 MHz counters, the difference frequency from the mixer is divided by two (2) or eight (8), respectively. To get a direct readout of the difference frequency, the counter time base is extended by a factor of two (2) or eight (8), respectively.

3.2.1 200 MHz Generator

Functional Description:

Refer to Figure 3-2.

A 50 MHz crystal oscillator with limited voltage control is phase locked to the 10 MHz frequency standard provided by the counter. The 50 MHz is multiplied to 200 MHz by two (2) times two (x 2) multiplier sections.

Circuit Description:

Refer to Master Board Schematic Diagram (dwg. no. D436859).

The 50 MHz crystal oscillator is made up of transistor Q4, crystal Y1, tuning elements L2, L3, C2, C14, C15, C13, and voltage controlled capacitor CR2. The output of the crystal oscillator is capacitively coupled to the phase comparator by C7. The 50 MHz signal is amplified by transistor Q3 which modulates the common mode emitter cur-

rent of the differential transistor pair Q1 and Q2. The 10 MHz reference drives the differential pair through capacitor C1. The collector current in the differential pair contains the phase information, as a low frequency or dc component depending on whether this loop is searching or locked, respectively. Capacitors C5 and C6 serve as a primary filter to remove the 10 MHz and 50 MHz components.

The operational amplifier Z1 provides loop gain, as well as a loop filter function producing the dominant time constant of the loop. The output of Z1 is the voltage control signal which drives the voltage variable capacitor CR2. Transistor Q5 is a buffer amplifier stage for the 50 MHz crystal oscillator. Transistor Q6 is the first doubler giving a 100 MHz output. Transistor Q7 is the second doubler, giving a 200 MHz output which is passed through a filter and amplified by transistors Q8 and Q9. The output of Q9 is then matched to drive the harmonic generator.

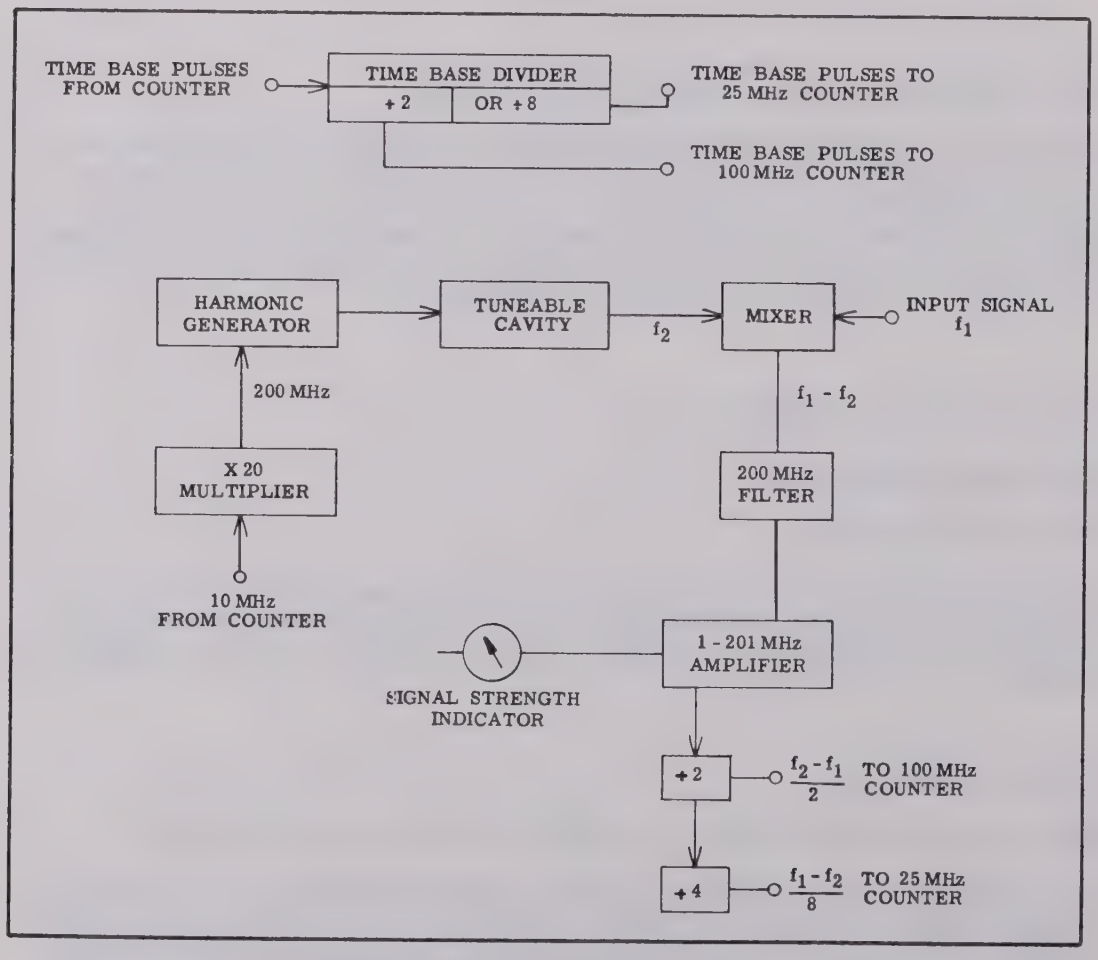


Figure 3-1. Model 613 Block Diagram

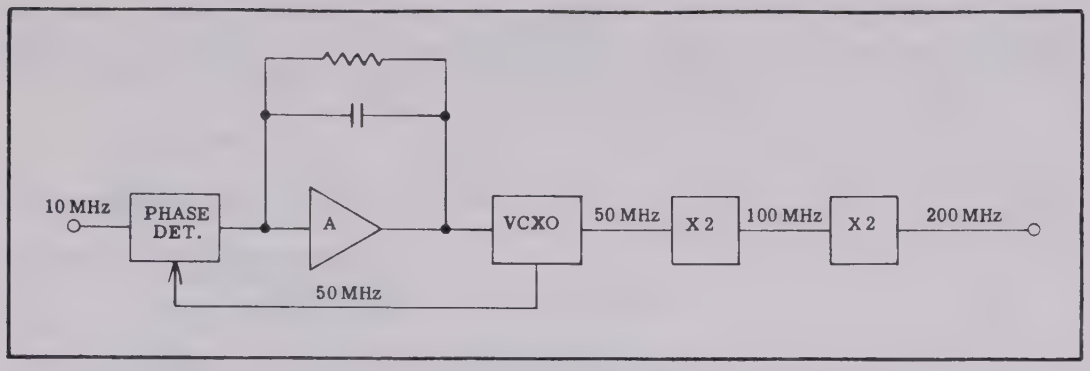


Figure 3-2. 200 MHz Generator Functional Block Diagram

3.2.2 Harmonic Generator

Refer to the Microwave Assembly Schematic Diagram (no. B550081).

The harmonic generator has additional matching circuity which is adjusted to match the 200 MHz into the varactor diode CR1. The varactor diode is coupled to the tuning cavity where the proper harmonics of 200 MHz are resonated. The cavity is coaxially coupled to the input signal and the mixing diodes, CR2 and CR3. The input line has a 6 db T-pad to improve VSWR and reduce the interaction of the cavity with the signal source. The residual input frequency, cavity signal and their sum are shunted to ground by capacitors C5 and C6 leaving only the difference frequency if the proper harmonic is selected in the cavity.

3.2.3 Video Amplifier

Functional Description:

Refer to Figure 3-3.

The AUX IN signal and the output of the microwave mixer are summed into the video amplifier. The video amplifier provides a bandwidth from 1 MHz to 200 MHz, with sufficient gain to drive the prescaler. The amplifier is broken into two sections: one drives a peak detector, and the AUX OUT function; the other drives a frequency discriminator and the prescaler. The peak detector gives the relative signal strength information. The frequency discriminator gives in-band or out-of-band information. The signal strength and frequency information is summed and amplified to drive the indicating meter, and to inhibit the prescaler.

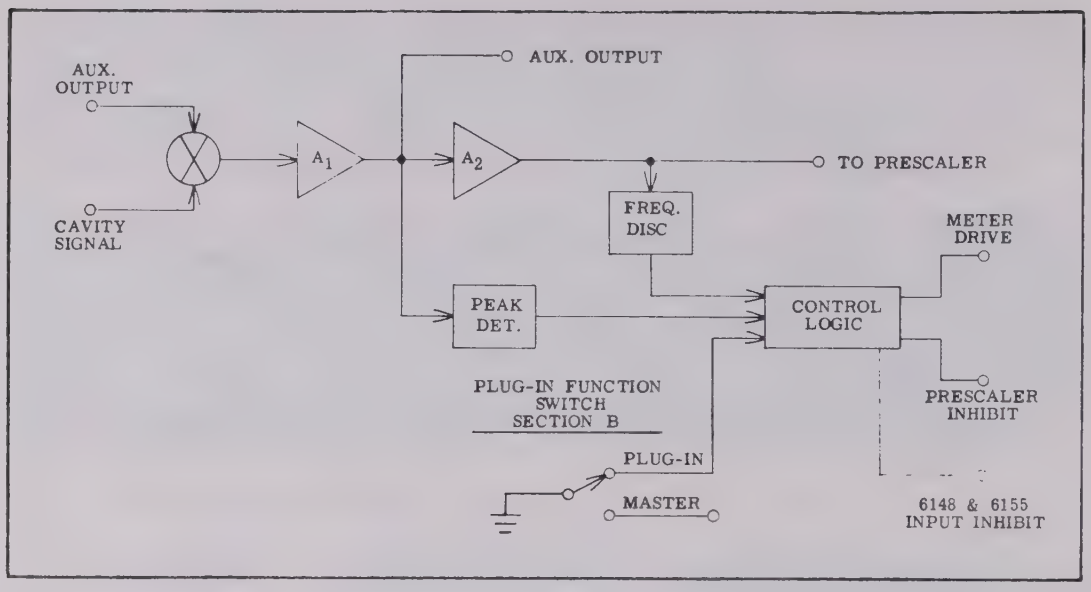


Figure 3-3 Video Amplifier Functional Block Diagram

Circuit Description:

Refer to Video Amplifier Schematic Diagram (dwg. no. D436849).

The mixer signals are summed in the transformer, T1. The output of T1 is summed with the AUX input signal through R3 and C6. The combined signal paths then drive the four cascaded video amplifier stages. transistors Q1, Q2, Q3, and Q4. The output of transistor Q4 drives transistor Q11 which functions as a peak detector. Capacitors C42 and C43 filter the detected signal. The filtered signal is then amplified by the differential transistor pair Q12 and Q13. The output is buffered by emitter follower, transistor Q14. The output of transistor Q4 also drives the output amplifier stage transistor Q5. The output of transistor Q5 is used to drive the prescaler. The output is also buffered by transistor Q6 which drives the frequency discriminator.

The series resonant elements C33-L6 and C36-L7 produce differential peak amplitude signals which are peak detected by diodes CR1 and CR2. When the frequency is below resonance, C36-L7 gives the largest signal; above resonance C33-L6 give the largest signal. The output of the discriminator is amplified by differential transistor pairs Q7-Q8, and Q9-Q10. The frequency information on the output of Q9 is summed with the signal strength information on the emitter of Q14 with resistors R63 and R64. Q15 is used as the summing element. Transistors Q16

and Q17 amplify the resultant transistor. Q16 drives the indicating meter. The signal from transistor Q17 is combined with the plug-in mode switch to produce the prescaler inhibit signal.

3.2.4 Frequency Prescaler

Functional Description:

Refer to Figure 3-4.

The output from the video amplifier is shaped and frequency divided by a factor of two (2). The output of the divider is buffered and gated as an output with a frequency range of 0.5 MHz to 100 MHz. The output of the divider is also used to drive a frequency divide-by-four (÷ 4) using two (2) sequential divide-by-two (÷ 2) circuits.

The output of the divide-by-four (÷ 4) is buffered and gated as an output with a frequency range of 0.125 MHz to 25 MHz. The 0.5 MHz to 100 MHz output is always active. The divide-by-four (÷ 4) subsequent buffer and gate are activated by positioning the scale factor switch in the 25 MHz position. The inhibit signal blocks both outputs when the video signal level is inadequate or the video frequency is higher than the counter can handle.

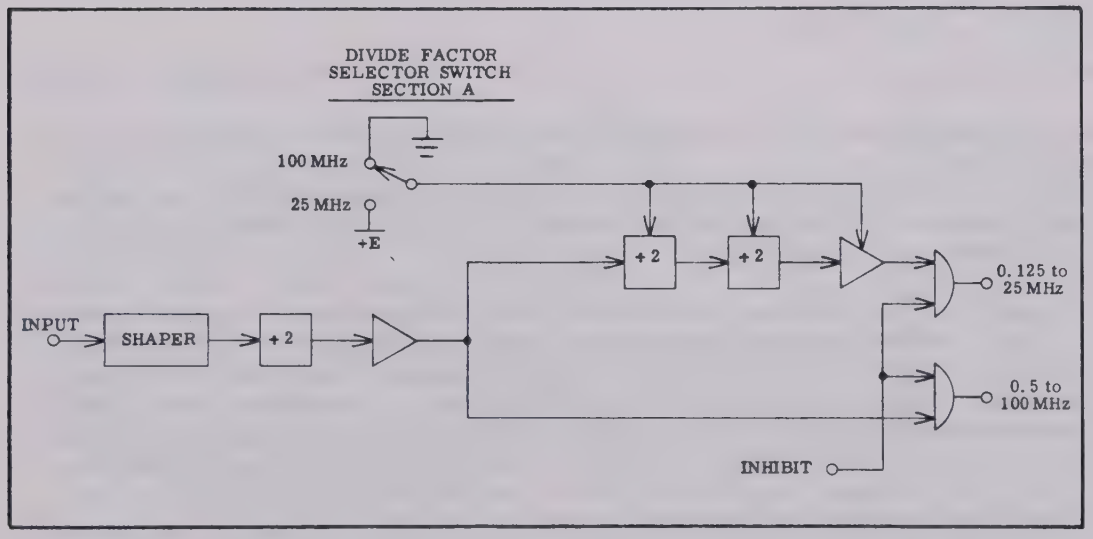


Figure 3-4. Frequency Prescaler Functional Block Diagram

Circuit Description:

Refer to the Video Amplifier Schematic Diagram (no. D436859).

Transistor Q201 buffers the signal from the video amplifier, and provides the tunnel diode CR202 with a low impedance current mode drive. The negative transition of the tunnel diode is differentiated and the resultant pulse level translated by Q202.

The divide-by-two is a current mode non-saturating bistable circuit. Transistors Q203-Q204 are the active elements. Zener diodes CR204 and CR205 are the positive feedback paths to provide bistable operation. Inductors L202 and L203 are the energy storage and steering elements to produce the frequency dividing operation. The divide-by-two is buffered by transistors Q205 and Q206. Transistor Q207 buffers and amplifies the divider output. The collector signal of Q207 is capacitively coupled (C211) to the inhibit gate (R233-R234-CR208).

The emitter signal of Q207 drives Q208 which in turn drives the divide-by-four. The divide-by-four is two monolithic JK flip-flops in series (Z201-Z202). The output of Z202 is buffered and amplified by transistor Q209. The collector signal of Q209 is gated by transistors Q210 and Q211 through diode CR209. When the inhibit signal is at ground, both outputs are blocked. When the the inhibit signal is +5 volts, both outputs are enabled.

3.2.5 Time Base Divider Circuit

Functional Description:

Refer to Figure 3-5.

The time base divider is used to divide the time base in the counter by a factor of two (2) or eight (8). This division extends the gate time of the counter to provide a direct display of the measurement. The time base divider consists of three divide-by-two (÷ 2) circuits, a shaping circuit, and an enable gate structure.

When the scale factor switch is in the 25 MHz position, the scale factor is eight (8) and all three dividers are active. The counter reset signal sets all of the dividers to the zero (0) state. When the time base signal is started, the output of the divider chain is shaped and gated into the counter start/stop lines. The enable gate blocks the start/stop signals when the MASTER/PLUG-IN mode switch is in the MASTER position, and passes the signals when the MASTER/PLUG-IN mode switch is in the PLUG-IN position.

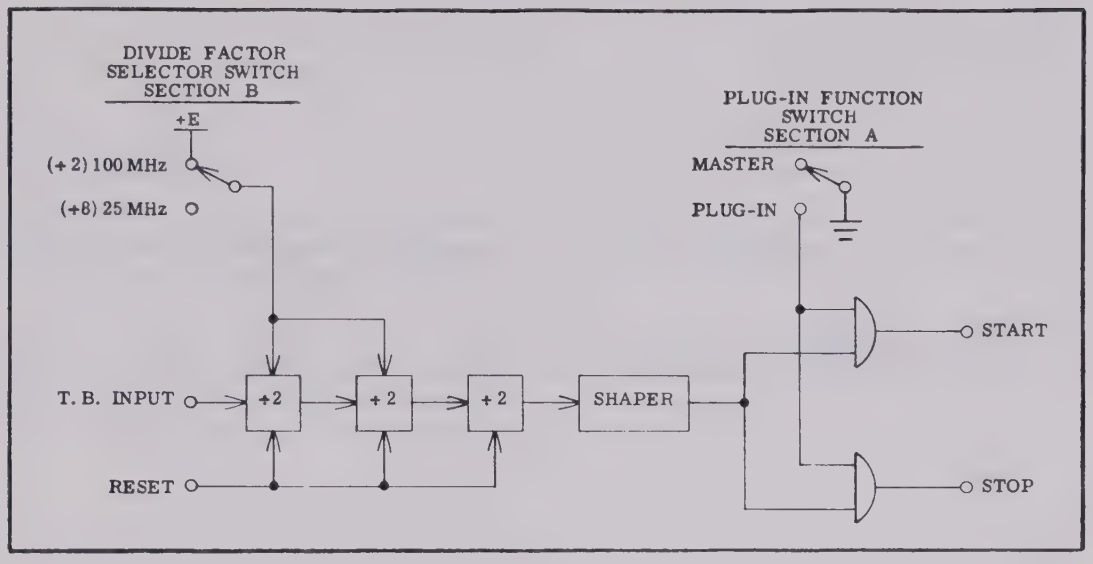


Figure 3-5. Time Base Divider Functional Block Diagram

When the scale factor switch is in the 100 MHz position, the scale factor is two (2). The first two dividers are converted from bistable counting circuits to monostable repeater circuits. When the time base signal is applied, the first two dividers act as repeaters, while the third divider counts the signal down by two (2).

Circuit Description:

Refer to the Video Amplifier Schematic Diagram (no. D436859).

Transistors Q105-Q106 are the active elements in the third divider. R123-C111-CR109, and R131-C114-CR112 are positive beedback paths for bistable operation. The reset signal is applied to the base of Q105 through R128. The reset state is Q105 on to ground, Q106 off to -12 volts. The input signal is applied to C111-C114. R123-CR109 and R131-CR112 steer the input for frequency divider operation. The first two dividers are the same as the third with the exception of R112 and R118. When +15 volts is switched to these resistors, a bias is applied to the bases of Q102 and Q104, respectively, converting the circuits to monostable operation.

The output of the third divider is buffered by an emitter follower (Q107), shaped by a Schmitt trigger (Q108-Q109), and gated (C118-R142-CR113-CR114) for the start signal and (C119-R141-CR115-CR116) for the stop signal.

SECTION 4

MAINTENANCE

4.1 GENERAL

The Model 613 is a complex piece of electronic equipment consisting of interrelated components. Calibration or troubleshooting requires the use of extensive test equipment.

No preventive maintenance or periodic calibration is necessary. Should service be required we recommend that you contact the factory or your nearest field service representative.

SECTION 5

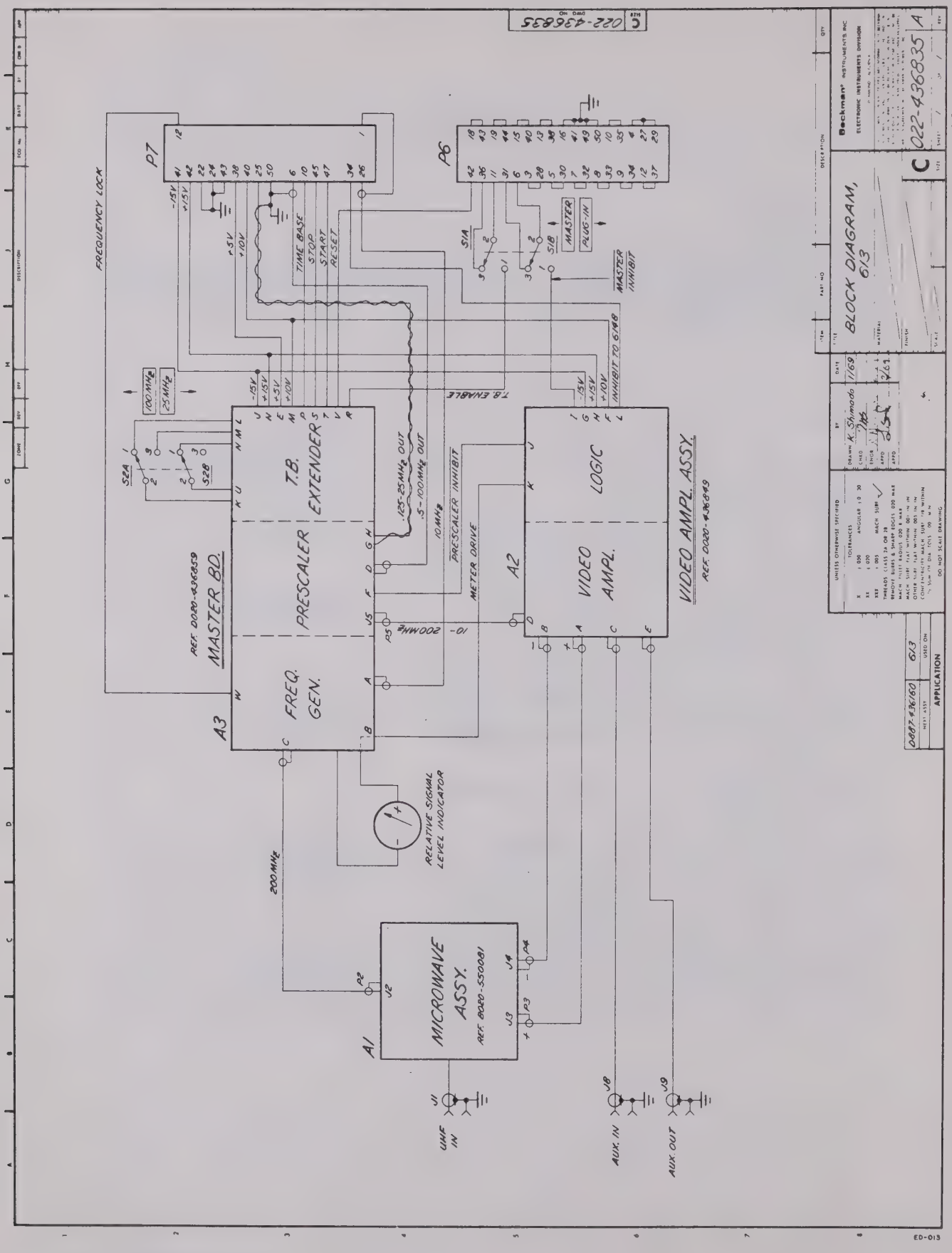
DIAGRAMS AND PARTS LISTS

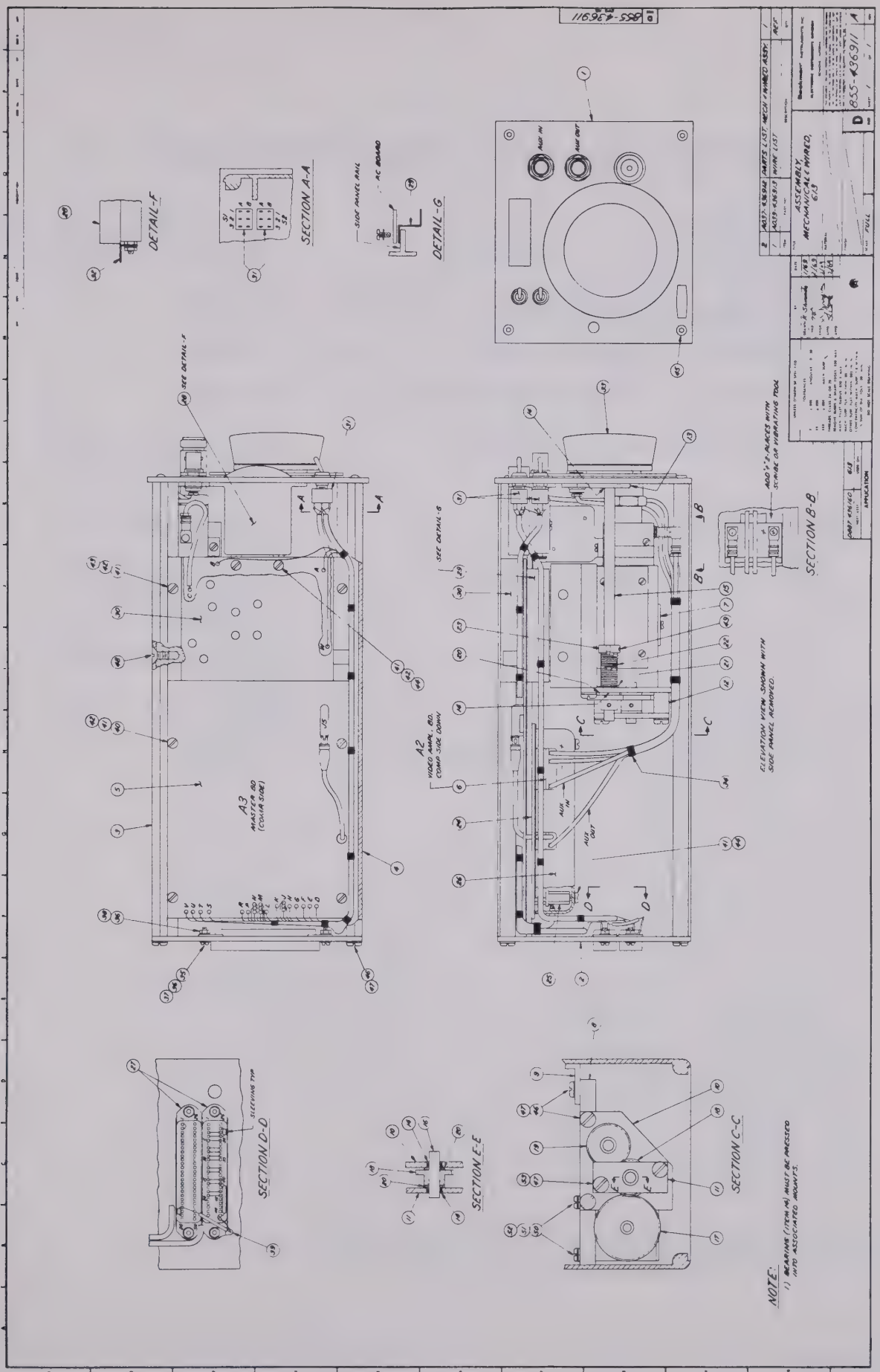
5.1 GENERAL

This section contains diagrams and parts lists for the Model 613. Parts lists for individual assemblies are located with their respective component layout drawings and schematic diagrams. Table 5-1 lists the diagrams and parts lists.

Table 5-1. Diagrams and Parts Lists

Description	Dwg. No.	Page
Model 613 Block Diagram	C436835-A	5-2
Mechanical & Wired Assembly Diagram	D436911-A	5-3
Mechanical & Wired Assembly Parts List		5-4
Comb Generator P. C. Board Diagram	A550084-A	5-5
Microwave Assembly Parts List with Mixer Cavity and Comb Generator		5-6
Microwave Assembly Schematic Diagram	B550081-A	5-7
Video Amplifier P. C. Board Assembly Diagram	B436850-A	5-8
Video Amplifier P. C. Board Assembly Parts List		5-9
Video Amplifier Schematic Diagram	D436849-A	5-12
Master Board P. C. Assembly Diagram	C436860-A	5-13
Master Board P. C. Assembly Parts List		5-14
Master Board Schematic Diagram (Page 1 of 2)	D436859-A	5-19
Master Board Schematic Diagram (Page 2 of 2)	D436859-A	5-20


FREQUENCY LOCK
P7
P6
-15V
+15V
+5V
+10V
TIME BASE
STOP
START
RESET
S1A
S1B
MASTER
PLUG-IN
MASTER INHIBIT
INHIBIT TO 6/48
T.B. ENABLE
100 MHz
25 MHz
S2A
S2B
T.B. EXTENDER
PRESCALER
MASTER BD.
REF. 0020-436859
A3
FREQ. GEN.
.125-25MHz OUT
.5-100MHz OUT
10MHz
PRESCALER INHIBIT
METER DRIVE
200MHz
A2
VIDEO AMPL.
LOGIC
VIDEO AMPL. ASSY.
REF. 0020-436849
RELATIVE SIGNAL LEVEL INDICATOR
A1
MICROWAVE ASSY.
REF. 0020-550091
UHF IN
AUX. IN
AUX. OUT
J1
J8
J9
Beckman INSTRUMENTS, INC
ELECTRONIC INSTRUMENTS DIVISION
BLOCK DIAGRAM, 6/3
C
022-436835
A
DRAWN K. Shimada 1/69
CHKD
ENGR
APPD
MFG APPD
UNLESS OTHERWISE SPECIFIED
TOLERANCES
APPLICATION
NEXT ASSY
USED ON
6/3
0087-436/60
DO NOT SCALE DRAWING

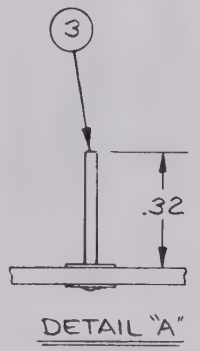

DETAIL-F
SECTION A-A
DETAIL-G
SECTION B-B
SECTION D-D
SECTION E-E
SECTION C-C
A3 MASTER BD (COMP SIDE)
A2 VIDEO AMPL BD (COMP SIDE DOWN)
ELEVATION VIEW SHOWN WITH SIDE PANEL REMOVED.
NOTE:
1) BEARING (ITEM 14) MUST BE PRESSED INTO ASSOCIATED MOUNTS.

MECHANICAL AND WIRED ASSEMBLY PARTS LIST

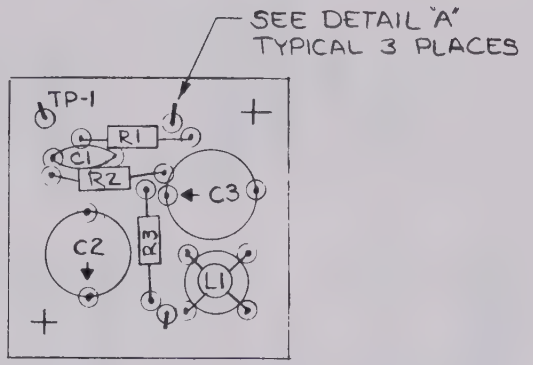
Item* No.	Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
		855-436911-A	Mechanical & Wired Assy.	Beckman	
5	A3	855-436860	Master Board P.C. Assy.	Beckman	1
6	A2	855-436850	Video Amplifier P.C. Assy.	Beckman	1
7	A1	449-550072	Microwave Assembly	Beckman	1
17		201-857495	Gear - 110T-AB	Dynamic Gear Co. Dynaco-AB-350-110/.1875 SS	1
18		201-857493	Gear - 66T	Dynamic Gear Co. 354-66S	1
19		201-857494	Gear - 70T-AB	Dynamic Gear Co. Dynaco-AB-350-70/.250 SS	1
27		672-824945	Connector	Amphenol 57-10500	2
28		809-436852	Meter	Beckman	1
31	S1,2	701-857323	Switch, Toggle	C & K 7201	2
33		060-436924	Kit, Dial Assembly	Beckman	1

*Item numbers not listed are hardware or fabricated parts.

REVISIONS				
ZONE	SYM	DESCRIPTION	DATE	APPROVAL



DETAIL "A"



ITEM	REQD	PART NO.	DESCRIPTION	MATL.	MATL SPEC	UNIT WT
3	1 1/8"	22-103-03	NO.-22 BARE SOLID BUSS WIRE	COPPER		
1		A037-436919	PARTS LIST, P.C. BD., COMB GEN.			

LIST OF MATERIALS

NEXT ASSY.	USED ON
855-550125	613

APPLICATION

UNLESS OTHERWISE SPECIFIED

TOLERANCES
.X ±.050 ANGULAR ± 0° 30'
.XX ±.020
.XXX ±.005 MACH. SURF. ✓
THREADS: CLASS 2A OR 2B
REMOVE BURRS & SHARP EDGES .020 MAX.
MACH. FILLET RADIUS .020 R MAX
MACH. SURF. FLAT WITHIN .001 IN/IN
OTHER SURF. FLAT WITHIN .005 IN/IN
CONCENTRICITY MACH. SURF. TIR WITHIN ½ SUM OF DIA. TOLS., .001 MIN
DO NOT SCALE DRAWING

	BY	DATE
DRAWN	R W HANNA	2/13/68
CHKD		
ENGR		2-6
APPD		
APPD		

TITLE: P.C. BOARD COMB GENERATOR

MATERIAL

FINISH

SCALE 2 - 1

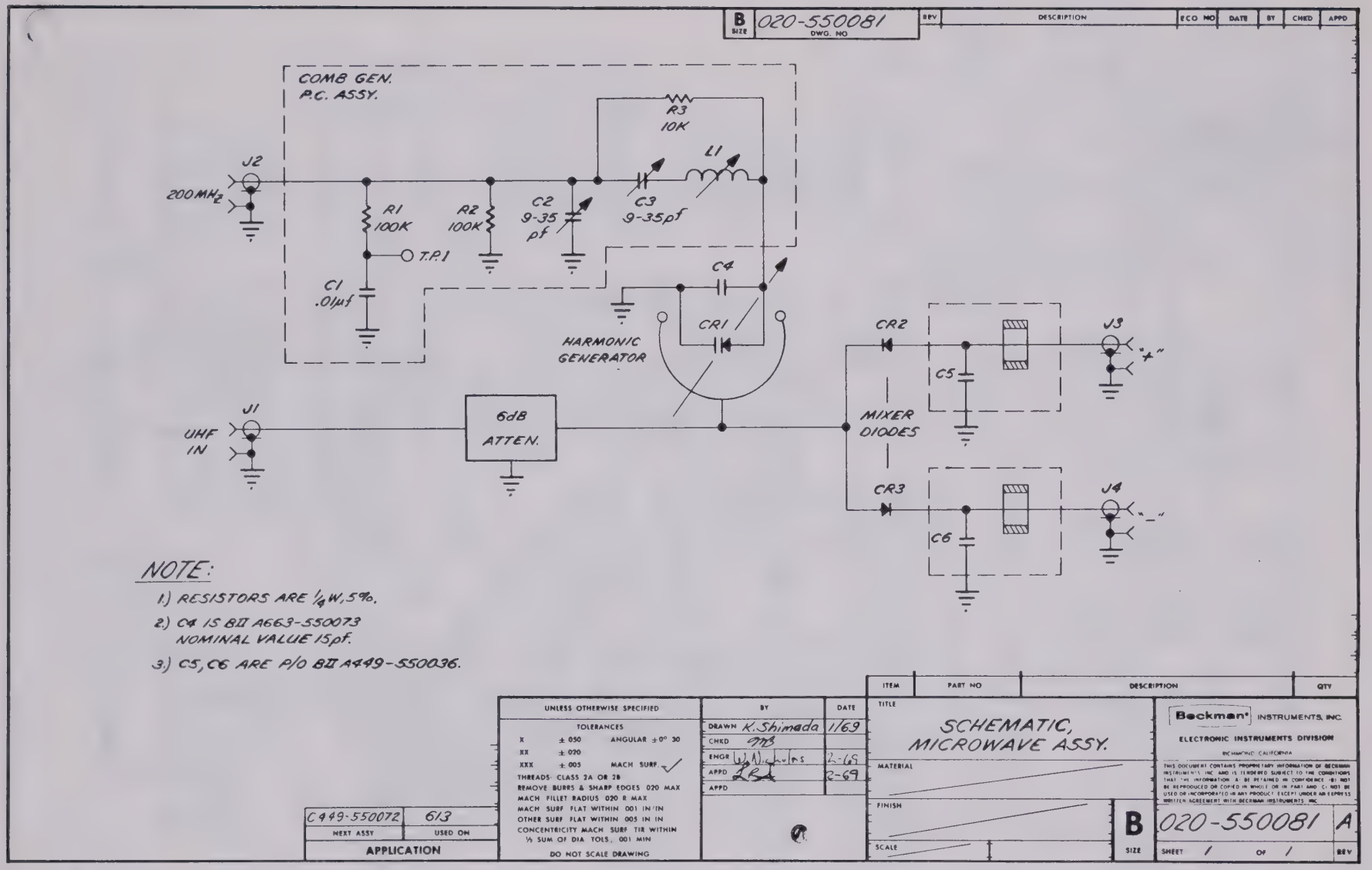
ADVANCED TECHNOLOGY CORPORATION
TIMONIUM MARYLAND
A Beckman SUBSIDIARY

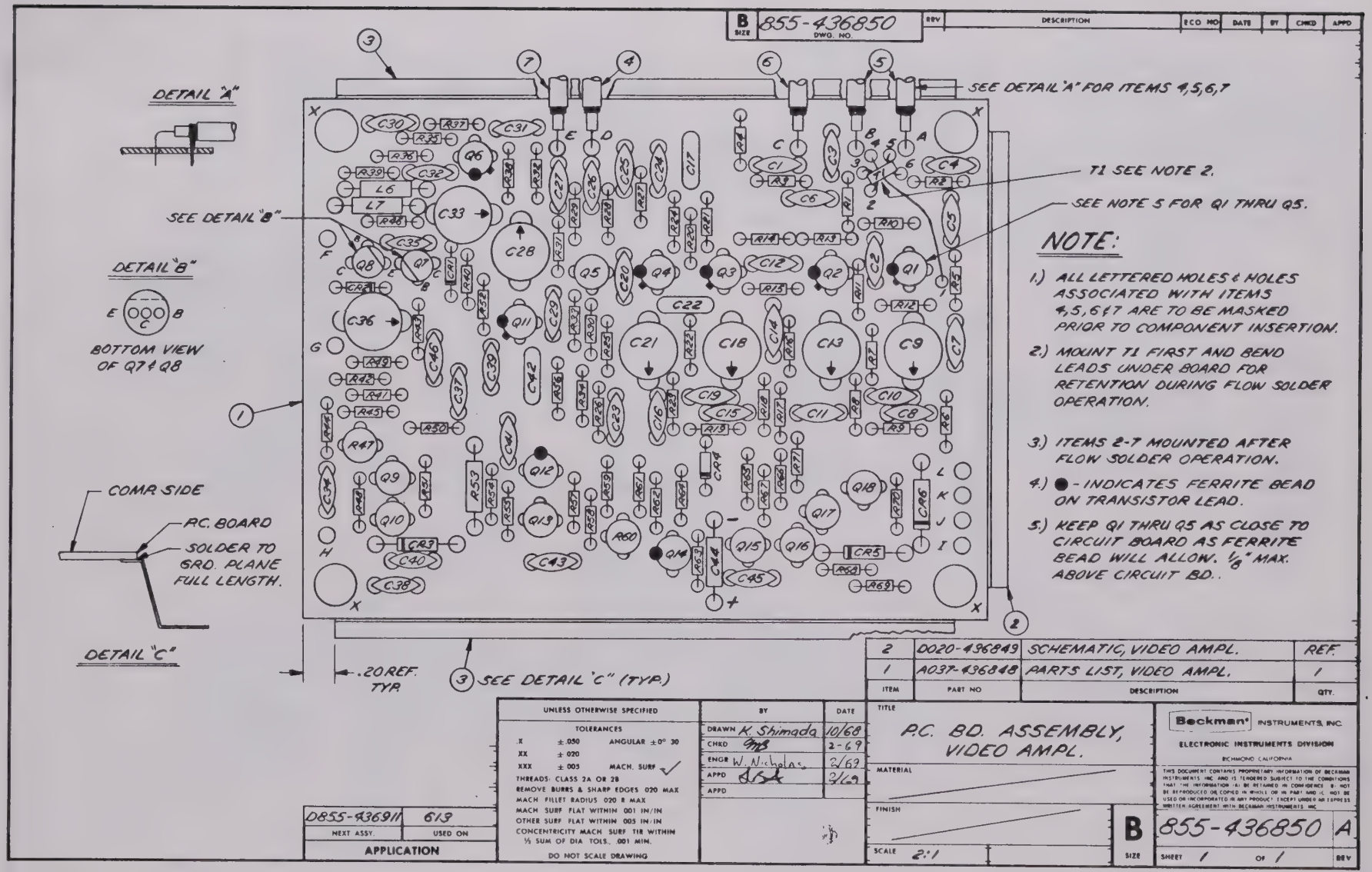
SIZE	CODE	SHT 1 OF 1
A	855-550084	A

ATC-BII-1(10/67)

PARTS LISTS
MICROWAVE ASSEMBLY

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty. / Assy.
A1	449-550072	Microwave Assembly	Beckman	
	449-550000	Probe Drive Assembly	Beckman	1
	449-440018	Mixer Cavity Assembly	Beckman	1
	689-550125	Comb Generator Assembly	Beckman	1
		Mixer Cavity Assembly		
	449-550018	Mixer Cavity Assembly	Beckman	
	617-857521	Attenuator, 6dB	Filmohm Corp. E7212-6	1
C5, 6	449-550036	By-Pass Capacitor	Beckman	2
CR2, 3	755-857522	Mixer Diodes, Matched Pair	Sylvania D5506BM	1 pr.
J3, 4	670-857487	Connector, Jack	Sealectro "Conhex" 51-045-0000	2
		Comb Generator Assembly		
	689-550125	Comb Generator Assembly	Beckman	
	449-550126	Crystal Assembly	Beckman	1
C4	663-550073	By-Pass Capacitor	Beckman	1
CR1	755-857526	Diode Chip	Varian VAS-21A	1
	855-550084A	Comb Generator P.C. Bd. Assy.	Beckman	
C1	633-836864	Capacitor, 0.01μf, 50V	Sprague 19C214A6/ TG-S10	1
C2, 3	643-843845	Capacitor, Var., 9-35pf	Erie 538-011E2-P094R	2
L1	795-550074	Inductor, Variable	Beckman	1
R1, 2	601-823904	Resistor, 100K, 1/4W, 5%	Allen Bradley CB1045	2
R3	601-822324	Resistor, 10K, 1/4W, 5%	Allen Bradley CB1035	1


B SIZE
020-550081
DWG. NO
REV
DESCRIPTION
ECO NO
DATE
BY
CHKD
APPD
COMB GEN.
P.C. ASSY.
R3
10K
L1
J2
200 MHz
R1
100K
R2
100K
C2
9-35
pf
C3
9-35pf
T.P.1
C1
.01μf
C4
CR1
HARMONIC
GENERATOR
CR2
J3
"+"
C5
MIXER
DIODES
J1
UHF
IN
6dB
ATTEN.
CR3
J4
"-"
C6
NOTE:
1.) RESISTORS ARE 1/4W, 5%.
2.) C4 IS BII A663-550073
NOMINAL VALUE 15pf.
3.) C5, C6 ARE P/O BII A449-550036.
ITEM
PART NO
DESCRIPTION
QTY
UNLESS OTHERWISE SPECIFIED
TOLERANCES
X ± 050 ANGULAR ±0° 30
XX ± 020
XXX ± 003 MACH SURF ✓
THREADS: CLASS 2A OR 2B
REMOVE BURRS & SHARP EDGES 020 MAX
MACH FILLET RADIUS 020 R MAX
MACH SURF FLAT WITHIN 001 IN/IN
OTHER SURF FLAT WITHIN 005 IN IN
CONCENTRICITY MACH SURF TIR WITHIN
½ SUM OF DIA TOLS, 001 MIN
DO NOT SCALE DRAWING
BY
DATE
DRAWN K. Shimada 1/69
CHKD
ENGR
APPD 2-69
APPD
TITLE
SCHEMATIC,
MICROWAVE ASSY.
MATERIAL
FINISH
SCALE
B SIZE
Beckman INSTRUMENTS, INC.
ELECTRONIC INSTRUMENTS DIVISION
020-550081
A
SHEET 1 OF 1
REV
C449-550072
613
NEXT ASSY
USED ON
APPLICATION


B SIZE 855-436850 DWG. NO.
REV DESCRIPTION ECO NO DATE BY CHKD APPD
DETAIL "A"
SEE DETAIL "A" FOR ITEMS 4,5,6,7
T1 SEE NOTE 2.
SEE NOTE 5 FOR Q1 THRU Q5.
SEE DETAIL "B"
DETAIL "B"
BOTTOM VIEW OF Q7 & Q8
COMP SIDE
P.C. BOARD
SOLDER TO GRD. PLANE FULL LENGTH.
DETAIL "C"
.20 REF. TYP.
3 SEE DETAIL "C" (TYP.)
NOTE:
1.) ALL LETTERED HOLES & HOLES ASSOCIATED WITH ITEMS 4,5,6 & 7 ARE TO BE MASKED PRIOR TO COMPONENT INSERTION.
2.) MOUNT T1 FIRST AND BEND LEADS UNDER BOARD FOR RETENTION DURING FLOW SOLDER OPERATION.
3.) ITEMS 2-7 MOUNTED AFTER FLOW SOLDER OPERATION.
4.) ● - INDICATES FERRITE BEAD ON TRANSISTOR LEAD.
5.) KEEP Q1 THRU Q5 AS CLOSE TO CIRCUIT BOARD AS FERRITE BEAD WILL ALLOW. 1/8" MAX. ABOVE CIRCUIT BD..
2 D020-436849 SCHEMATIC, VIDEO AMPL. REF.
1 A037-436848 PARTS LIST, VIDEO AMPL. 1
ITEM PART NO DESCRIPTION QTY.
UNLESS OTHERWISE SPECIFIED
TOLERANCES
.X ±.050 ANGULAR ±0° 30
XX ± 020
XXX ± 005 MACH. SURF ✓
THREADS: CLASS 2A OR 2B
REMOVE BURRS & SHARP EDGES 020 MAX
MACH FILLET RADIUS 020 R MAX.
MACH SURF FLAT WITHIN 001 IN/IN
OTHER SURF FLAT WITHIN 005 IN/IN
CONCENTRICITY MACH SURF TIR WITHIN 1/3 SUM OF DIA TOLS., 001 MIN.
DO NOT SCALE DRAWING
BY DATE
DRAWN K. Shimada 10/68
CHKD 2-6-9
ENGR W. Nicholas 2/69
APPD 2/69
APPD
TITLE P.C. BD. ASSEMBLY, VIDEO AMPL.
MATERIAL
FINISH
SCALE 2:1
B SIZE
Beckman INSTRUMENTS, INC
ELECTRONIC INSTRUMENTS DIVISION
RICHMOND CALIFORNIA
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF BECKMAN INSTRUMENTS, INC. AND IS TENDERED SUBJECT TO THE CONDITIONS THAT THE INFORMATION IS TO BE RETAINED IN CONFIDENCE & NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART AND IT NOT BE USED OR INCORPORATED IN ANY PRODUCT EXCEPT UNDER AN EXPRESS WRITTEN AGREEMENT WITH BECKMAN INSTRUMENTS, INC.
855-436850 A
SHEET 1 OF 1 REV
D855-436911 NEXT ASSY. 613 USED ON
APPLICATION

VIDEO AMPLIFIER P.C. BOARD ASSEMBLY PARTS LIST

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
	855-436850-A	Video Amplifier P.C. Bd. Assy.	Beckman	
C1, 5, 8, 11, 15, 16, 26, 30, 31, 32, 34, 38, 39, 40, 41, 43, 45	633-836864	Capacitor, F., Cerm., 0.01μf, 50V	Sprague 19C214A6/ TG-S10	17
C2, 3, 4, 6, 10, 12, 14, 19, 20, 23, 24, 25, 27, 29	633-857507	Capacitor, F., Cerm., 0.1μf, 25V	JFD - DFJ-3	14
C7, 35, 37, 46	633-829971	Capacitor, F., Cerm., 1KV, 0.001μf	Sprague 5GA-D10	4
C9, 13, 18, 21, 28	643-846449	Capacitor, Var., 15-60pf	Erie 538-011P3P0-112R	5
C17, 22	637-822754	Capacitor, D., Mica, 47pf, 500V, 5%	Electromotive DM15-E470J0-500WV4CR	2
C33, 36	643-857409	Capacitor, Var., 2.5-11pf	Erie 538-011-2BP0-90L	2
C42	637-825349	Capacitor, D., Mica, 560pf, 300V, 5%	Electromotive DM15-F561J0-300WV4CR	1
C44	631-835596	Capacitor, Tant., 1μf, 35V, ±10%	Sprague 150D105X-9035A2	1
CR1, 2	755-430460	Diode, Special	Beckman	2
CR3, 4, 5	755-845049	Diode, FDH 627	Fairchild	3
CR6	755-420893	Diode, Special	Beckman	1
L1 thru 5, 8, 9, 10	783-807862	Ferrite Bead	Ferroxcube 56-590-65/3B	8
L6, 7	795-857506	Inductor, 0.05μH	Stanwych 1A0503M	2
Q1, 2, 3, 4, 6, 11	755-857419	Transistor, 2N5179	RCA	6
Q5	755-841100	Transistor, MPS 918	Motorola	1
Q7, 8	755-838078	Transistor, 2N3391	G.E. Semiconductor	2
Q9, 10	755-843526	Transistor, 2N3906	Motorola	2
Q12, 13, 14, 16	755-419596	Transistor, Special	Beckman	4
Q15	755-845089	Transistor, 2N4258	Fairchild	1

continued. . .

Video Amplifier P.C. Board Assembly Parts List - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
Q17, 18	755-857274	Transistor, 2N4275	Fairchild	2
R1, 2	601-841406	Resistor, 33K, 1/8W, 5%	*A. B. BB3335	2
R3, 36, 39	601-839628	Resistor, 100Ω, 1/8W, 5%	A. B. BB1015	3
R4	601-839626	Resistor, 82Ω, 1/8W, 5%	A. B. BB8205	1
R5, 6, 12, 61	601-839648	Resistor, 4.7K, 1/8W, 5%	A. B. BB4725	4
R7, 9, 18, 19, 27, 29, 51, 52	601-839604	Resistor, 10Ω, 1/8W, 5%	A. B. BB1005	8
R8, 17, 23, 24	601-839641	Resistor, 1.2K, 1/8W, 5%	A. B. BB1225	4
R10, 37, 45	601-839644	Resistor, 2.2K, 1/8W, 5%	A. B. BB2225	3
R11	601-839629	Resistor, 120Ω, 1/8W, 5%	A. B. BB1215	1
R13, 28	601-839634	Resistor, 330Ω, 1/8W, 5%	A. B. BB3315	2
R14	601-839636	Resistor, 470Ω, 1/8W, 5%	A. B. BB4715	1
R15, 20, 26	601-839637	Resistor, 560Ω, 1/8W, 5%	A. B. BB5615	3
R16, 22	601-839614	Resistor, 27Ω, 1/8W, 5%	A. B. BB2705	2
R21, 24	601-839631	Resistor, 180Ω, 1/8W, 5%	A. B. BB1815	2
R25, 33	601-839612	Resistor, 22Ω, 1/8W, 5%	A. B. BB2205	2
R30, 38	601-839622	Resistor, 56Ω, 1/8W, 5%	A. B. BB5605	2
R31, 32	601-839621	Resistor, 51Ω, 1/8W, 5%	A. B. BB5105	2
R35, 43, 56	601-841402	Resistor, 15K, 1/8W, 5%	A. B. BB1535	3
R40, 49	601-841417	Resistor, 270K, 1/8W, 5%	A. B. BB2745	2
R41, 42, 62	601-839649	Resistor, 5.6K, 1/8W, 5%	A. B. BB5625	3
R44, 50, 55	601-839642	Resistor, 1.5K, 1/8W, 5%	A. B. BB1525	3
R46, 59	601-839640	Resistor, 1K, 1/8W, 5%	A. B. BB1025	2
R47	613-844266	Resistor, Var., 50K, 1/2W, 30%	Helipot, Beckman Instruments, Inc.	1
R48, 63	601-839652	Resistor, 10K, 1/8W, 5%	A. B. BB1035	2
R53	601-823379	Resistor, 10Ω, 1/4W, 5%	A. B. BB1005	1
R54	601-839639	Resistor, 820Ω, 1/8W, 5%	A. B. BB8215	1
R57, 58	601-839616	Resistor, 33Ω, 1/8W, 5%	A. B. BB3305	2
R60	613-842098	Resistor, Var., 1K, 1/2W, 30%	Helipot Div.	1

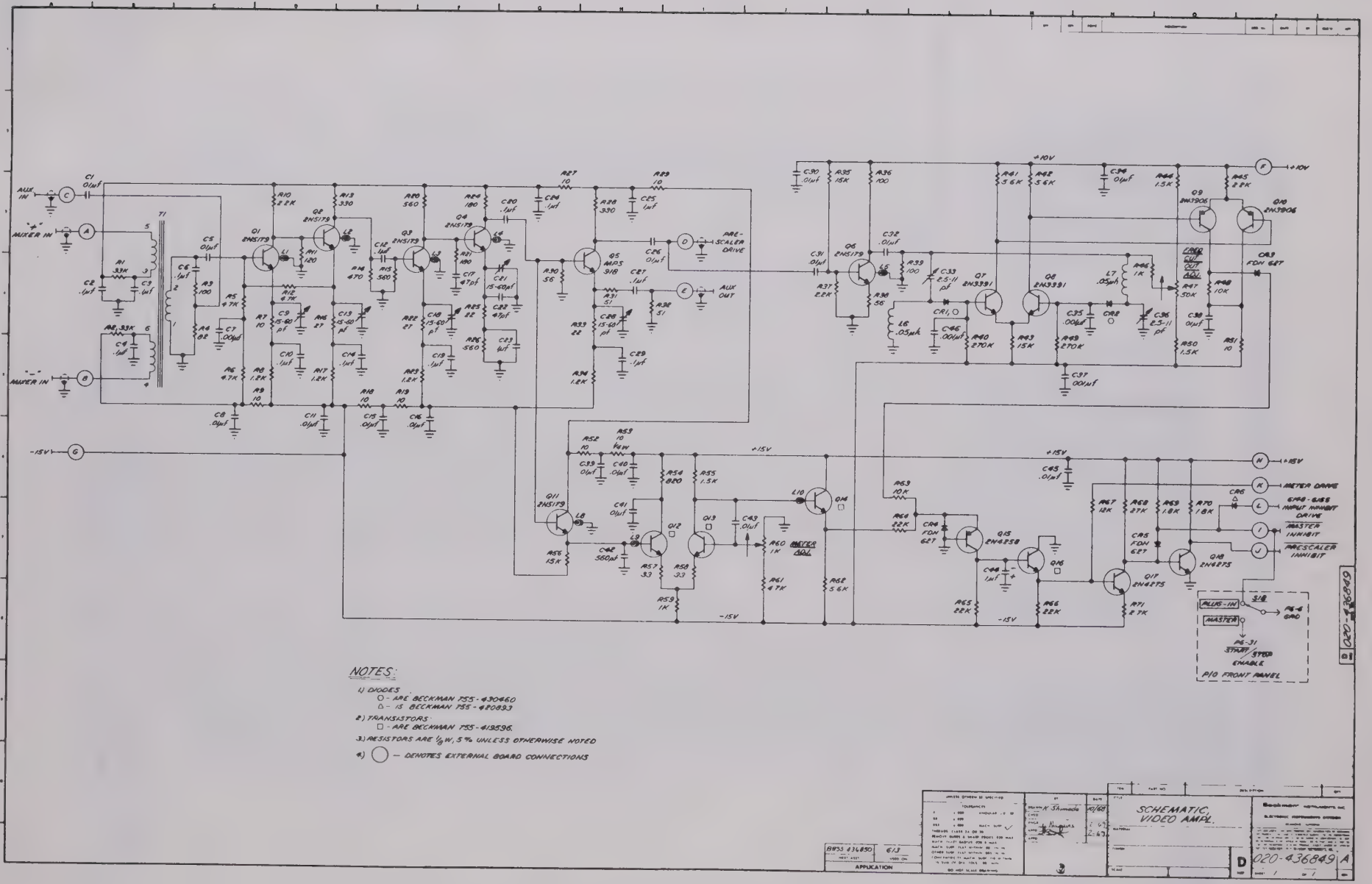
continued. . .

*"A. B" are Allen Bradley, fixed composition, resistors.

Video Amplifier P.C. Board Assembly Parts List - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
R64, 65, 66	601-841404	Resistor, 22K, 1/8W, 5%	*A.B. BB2235	3
R67	601-841401	Resistor, 12K, 1/8W, 5%	A.B. BB1235	1
R68	601-841405	Resistor, 27K, 1/8W, 5%	A.B. BB2735	1
R69, 70	601-839643	Resistor, 1.8K, 1/8W, 5%	A.B. BB1825	2
R71	601-839645	Resistor, 2.7K, 1/8W, 5%	A.B. BB2725	1
T1	792-436656	Transformer, Special	Beckman	1
	783-839727	Torroid Core (p/o T1)	Ferroxcube 213T050/ 3E2A	

*"A.B." are Allen Bradley, fixed composition, resistors.



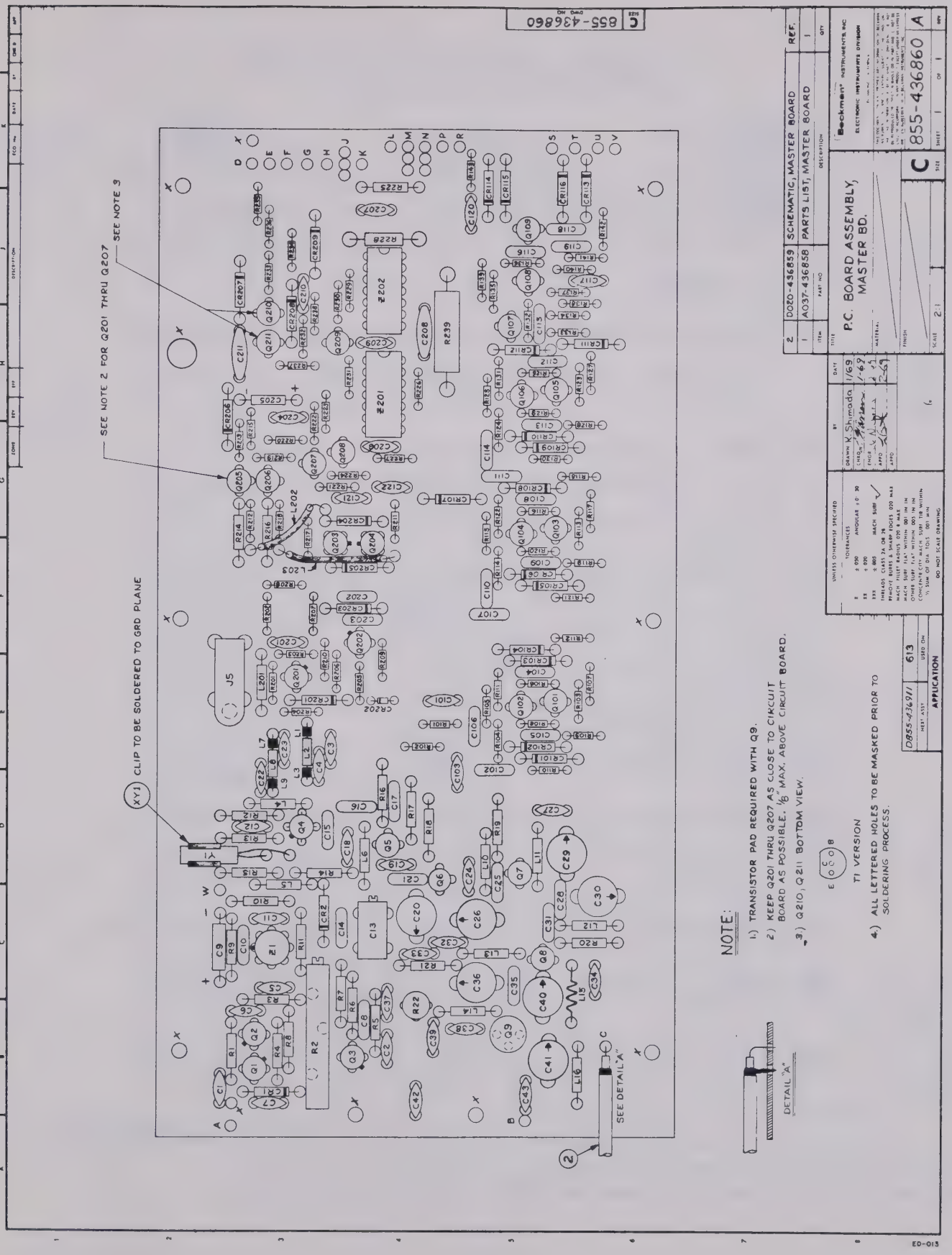
NOTES:

1) DIODES:
○ - ARE BECKMAN 755-430460
△ - IS BECKMAN 755-420893

2) TRANSISTORS:
□ - ARE BECKMAN 755-419596

3) RESISTORS ARE 1/8 W, 5% UNLESS OTHERWISE NOTED

4) ◯ — DENOTES EXTERNAL BOARD CONNECTIONS


SEE NOTE 2 FOR Q201 THRU Q207
SEE NOTE 3
CLIP TO BE SOLDERED TO GRD PLANE
SEE DETAIL "A"
DETAIL "A"
NOTE:
1.) TRANSISTOR PAD REQUIRED WITH Q9.
2.) KEEP Q201 THRU Q207 AS CLOSE TO CIRCUIT BOARD AS POSSIBLE. 1/8" MAX. ABOVE CIRCUIT BOARD.
3.) Q210, Q211 BOTTOM VIEW.
TI VERSION
4.) ALL LETTERED HOLES TO BE MASKED PRIOR TO SOLDERING PROCESS.
C 855-436860 A
2 D080-436859 SCHEMATIC, MASTER BOARD
1 A037-436858 PARTS LIST, MASTER BOARD
P.C. BOARD ASSEMBLY, MASTER BD.
Beckman INSTRUMENTS, INC
ELECTRONIC INSTRUMENTS DIVISION
D855-436911 613
APPLICATION
DO NOT SCALE DRAWING
ED-013

MASTER BOARD PARTS LIST

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
	855-436860-A	Master Board Assy.	Beckman	1
C1, 2, 11, 12, 43, 101, 103, 117, 120, 204, 207	633-836864	Capacitor, 0.01μf, 50V	Sprague 19C214A6/ TG-S10	11
C3, 4, 5, 18, 19, 22, 23, 24, 27, 32, 33, 34, 37, 38, 39, 42, 121, 122, 209	633-829971	Capacitor, 0.001μf, 1KV	Sprague 5GA-D10	19
C6, 7	633-857509	Capacitor, 0.05μf, 100V	Sprague TG-S50	2
C8	*637-832428	Capacitor, 1pf, 500V, 5%	*DM15C010DC-500	1
C9, 205	631-835596	Capacitor, 1μf, 35V, 10%	Sprague 150D105X-9035A2	2
C10	637-825467	Capacitor, 30pf, 500V, 5%	DM15E300J0-500	1
C13	655-857511	Capacitor, Var., 1.2-16pf	JFD - VC961	1
C14	637-825069	Capacitor, 10pf, 500V, 5%	DM15C100JC-500	1
C15, 203	637-857368	Capacitor, 8.2pf, 500V, 5%	DM15C"8.2"D0500	2
C16, 21, 35	637-857364	Capacitor, 4.7pf, 500V, 5%	DM15C"4.7"D0500	3
C17	637-822756	Capacitor, 15pf, 500V, 5%	DM15C150J0-500	1
C20	643-843845	Capacitor, Var., 9-35pf	Erie Tech. 538-011E2P0945	1
C25	637-825071	Capacitor, 27pf, 500V, 5%	DM15E270J0-500	1
C26, 29, 30, 36, 41	643-857510	Capacitor, Var., 5.5-18pf	Erie Tech. 538-011-C0P0-92R	5
C28, 31	637-857358	Capacitor, 1.5pf, 500V, 5%	DM15C"1.5"D0500	2
C40	643-832923	Capacitor, Var., 7-25pf	Erie Tech. 011-C0P0-92R	1
C102, 106, 107, 110, 111, 114, 202, 210	637-832598	Capacitor, 22pf, 500V, 5%	DM15C220J0-500	8
C104, 105, 108, 109, 112, 113	637-822976	Capacitor, 33pf, 500V, 5%	DM15E330J0-500	6

continued. . .

*Beckman P/N "637" are Electromotive DM15...WV4CR capacitors.

Master Board Parts List - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
C115, 116	*637-822754	Capacitor, 47pf, 500V, 5%	*DM15E470J0-500	2
C118, 119	637-825335	Capacitor, 39pf, 500V, 5%	DM15E390J0-500	2
C201, 206	633-857507	Capacitor, 0.1μf, 25V	JFD DFJ-3	2
C208, 211	633-815873	Capacitor, 0.33μf, 25V	Sprague 5C023334D-8250B3	2
CR1	755-822858	Diode, Zener, 1N753A, 6.2V	Beckman	1
CR2	755-857512	Diode, Varactor, 1N5144	Motorola	1
CR101 thru CR116, 203, 208, 209	755-845049	Diode, FDH 627	Fairchild	19
CR201	755-857369	Diode, Zener, LVA47A, 4.7V	T.R.W.	1
CR202	755-836825	Diode, Tunnel, TD253	G.E., N.Y.	1
CR204, 205	755-822707	Diode, Zener, 1N748A, 3.9V	Beckman	2
CR206	755-821972	Diode, Zener, 1N750A, 4.7V	Beckman	1
CR207	755-430460	Diode, Special	Beckman	1
J5	697-838675	Connector, Co-Axial	Amp. 50105-1	1
L1, 3, 7, 9	783-807862	Ferrite Bead	Ferroxcube 56-590-65/3B	4
L2, 8	795-857519	Inductor, 3.3μH	Stanwych 1A3302M	2
L4	795-857517	Inductor, 0.56μH	Stanwych 1A5603M	1
L5, 6	795-857516	Inductor, 0.33μH	Stanwych 1A3303M	2
L10	795-857515	Inductor, 0.12μH	Stanwych 1A1203M	1
L11, 12, 13, 201	795-857506	Inductor, 0.05μH	Stanwych 1A0503M	4
L14	795-857518	Inductor, 1.0μH	Stanwych 1025-20	1
L15	795-550071	Inductor, 20nH, Special	Beckman	1
L15	795-857514	Inductor, 0.10μH	Stanwych 1A1003M	1
L202, 203	661-812193	Inductor, Wire, No. 24, Strd., White		4"
P2	661-436801	Cable Assembly	Beckman	1

continued. . .

*Beckman P/N "637" are Electromotive DM15...WV4CR capacitors.

Master Board Parts List - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
Q1, 2, 3, 4, 203, 204	755-857419	Transistor, 2N5179	RCA	6
Q5, 6, 7, 8, 107, 205, 206	755-841100	Transistor, MPS 918	Motorola	7
Q9	755-841581	Transistor, 2N3866	Beckman	1
Q101 thru Q106, 108, 109	755-424175	Transistor, MPS 500	Motorola	8
Q201, 202	755-857513	Transistor, 2N4261	Motorola	2
Q207, 208	755-845089	Transistor, 2N4258	Fairchild	2
Q209	755-425735	Transistor, Special	Beckman	1
Q210, 211	755-422494	Transistor, Special	Beckman	2
R1	601-823393	Resistor, 270Ω, 1/4W, 5%	*A.B. CB2715	1
R2	613-838748	Resistor, Var., 200Ω, 3/4W, 20%	Helipot 78P R200	1
R3, 20	601-822308	Resistor, 1K, 1/4W, 5%	A.B. CB1025	2
R4	601-823387	Resistor, 47Ω, 1/4W, 5%	A.B. CB4705	1
R5	601-823395	Resistor, 470Ω, 1/4W, 5%	A.B. CB4715	1
R6	601-823397	Resistor, 5.6K, 1/4W, 5%	A.B. CB5625	1
R7	601-822332	Resistor, 9.1K, 1/4W, 5%	A.B. CB9125	1
R8	601-817735	Resistor, 100Ω, 1/4W, 5%	A.B. CB1015	1
R9	601-819691	Resistor, 2.2Meg, 1/4W, 5%	A.B. CB2255	1
R10, 11, 15	601-823902	Resistor, 47K, 1/4W, 5%	A.B. CB4735	3
R12	601-801803	Resistor, 12K, 1/4W, 5%	A.B. CB1235	1
R13	601-822328	Resistor, 2.2K, 1/4W, 5%	A.B. CB2225	1
R14	601-823394	Resistor, 330Ω, 1/4W, 5%	A.B. CB3315	1
R16	601-822295	Resistor, 2.7K, 1/4W, 5%	A.B. CB2725	1
R17	601-822307	Resistor, 200Ω, 1/4W, 5%	A.B. CB2015	1
R18, 19	601-822324	Resistor, 10K, 1/4W, 5%	A.B. CB1035	2
R21	601-823379	Resistor, 10Ω, 1/4W, 5%	A.B. CB1005	1
R22	613-842098	Resistor, Var., 1K, 1/2W, 30%	Helipot	1

continued. . .

*"A.B." are Allen Bradley, fixed composition, resistors.

Master Board Parts List - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
R101, 102	601-839606	Resistor, 12Ω, 1/8W, 5%	*A. B. BB1205	2
R103, 111, 113, 122, 123, 131, 236	601-839649	Resistor, 5.6K, 1/8W, 5%	A. B. BB5625	7
R104, 105, 114, 115, 124, 125	601-841407	Resistor, 39K, 1/8W, 5%	A. B. BB3935	6
R106, 108, 116, 120, 126, 129	601-841401	Resistor, 12K, 1/8W, 5%	A. B. BB1235	6
R107, 110, 117, 121, 127, 130, 133, 134, 136	601-839645	Resistor, 2.7K, 1/8W, 5%	A. B. BB2725	9
R109, 119, 128	601-839651	Resistor, 8.2K, 1/8W, 5%	A. B. BB8225	3
R112, 118	601-841404	Resistor, 22K, 1/8W, 5%	A. B. BB2235	2
R132	601-839648	Resistor, 4.7K, 1/8W, 5%	A. B. BB4725	1
R135	601-839628	Resistor, 100Ω, 1/8W, 5%	A. B. BB1015	1
R137, 140, 204	601-839639	Resistor, 820Ω, 1/8W, 5%	A. B. BB8215	3
R138	601-839632	Resistor, 220Ω, 1/8W, 5%	A. B. BB2215	1
R139, 202, 233	601-839641	Resistor, 1.2K, 1/8W, 5%	A. B. BB1225	3
R141, 142, 238	601-841402	Resistor, 15K, 1/8W, 5%	A. B. BB1535	3
R143	601-839616	Resistor, 33Ω, 1/8W, 5%	A. B. BB3305	1
R201	601-839621	Resistor, 51Ω, 1/8W, 5%	A. B. BB5105	1
R203, 205, 219	601-839604	Resistor, 10Ω, 1/8W, 5%	A. B. BB1005	3
R206	601-839652	Resistor, 10K, 1/8W, 5%	A. B. BB1035	1
R207, 212, 218	601-839620	Resistor, 47Ω, 1/8W, 5%	A. B. BB4705	3
R208	601-839644	Resistor, 2.2K, 1/8W, 5%	A. B. BB2225	1

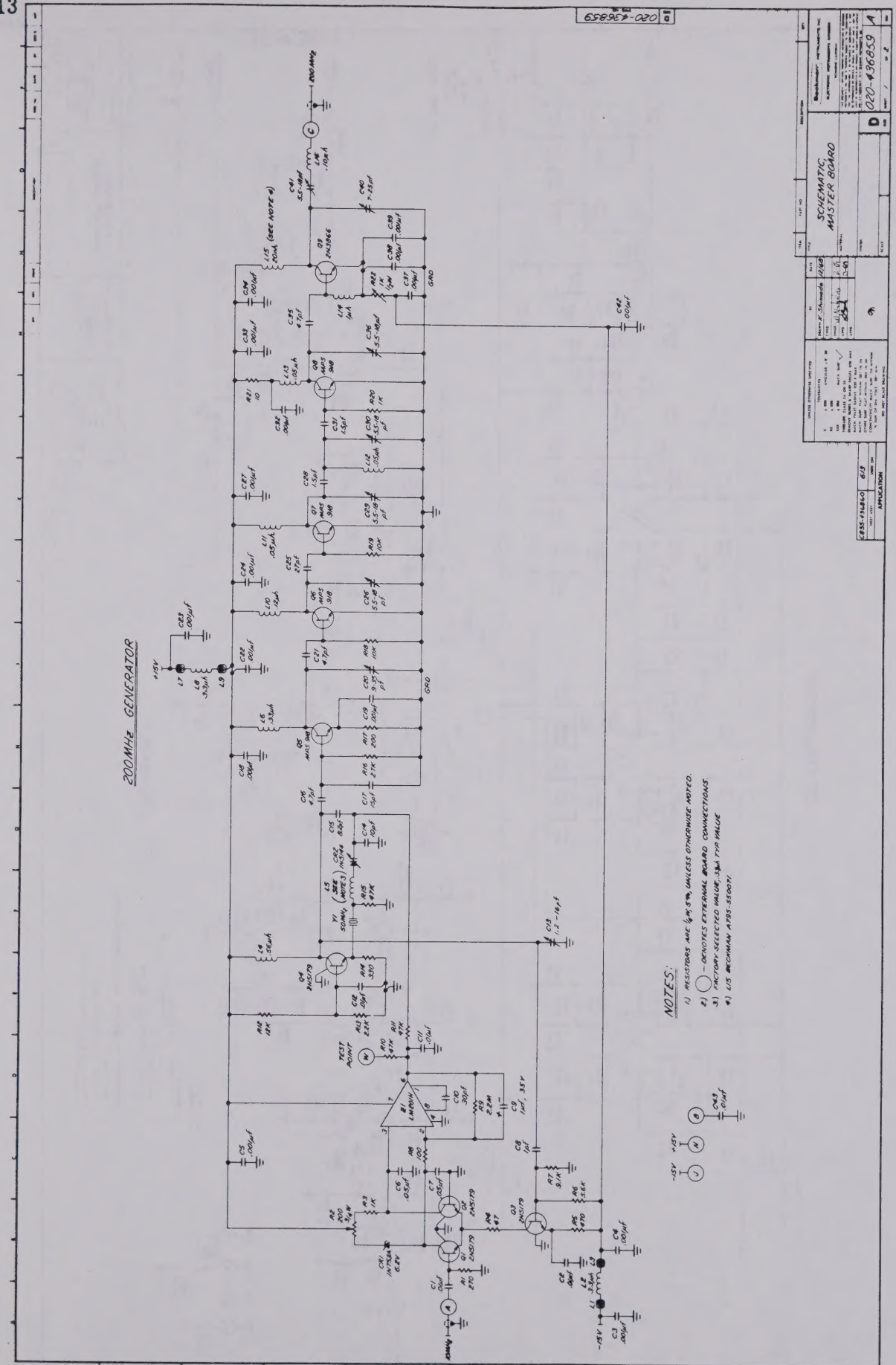
continued. . .

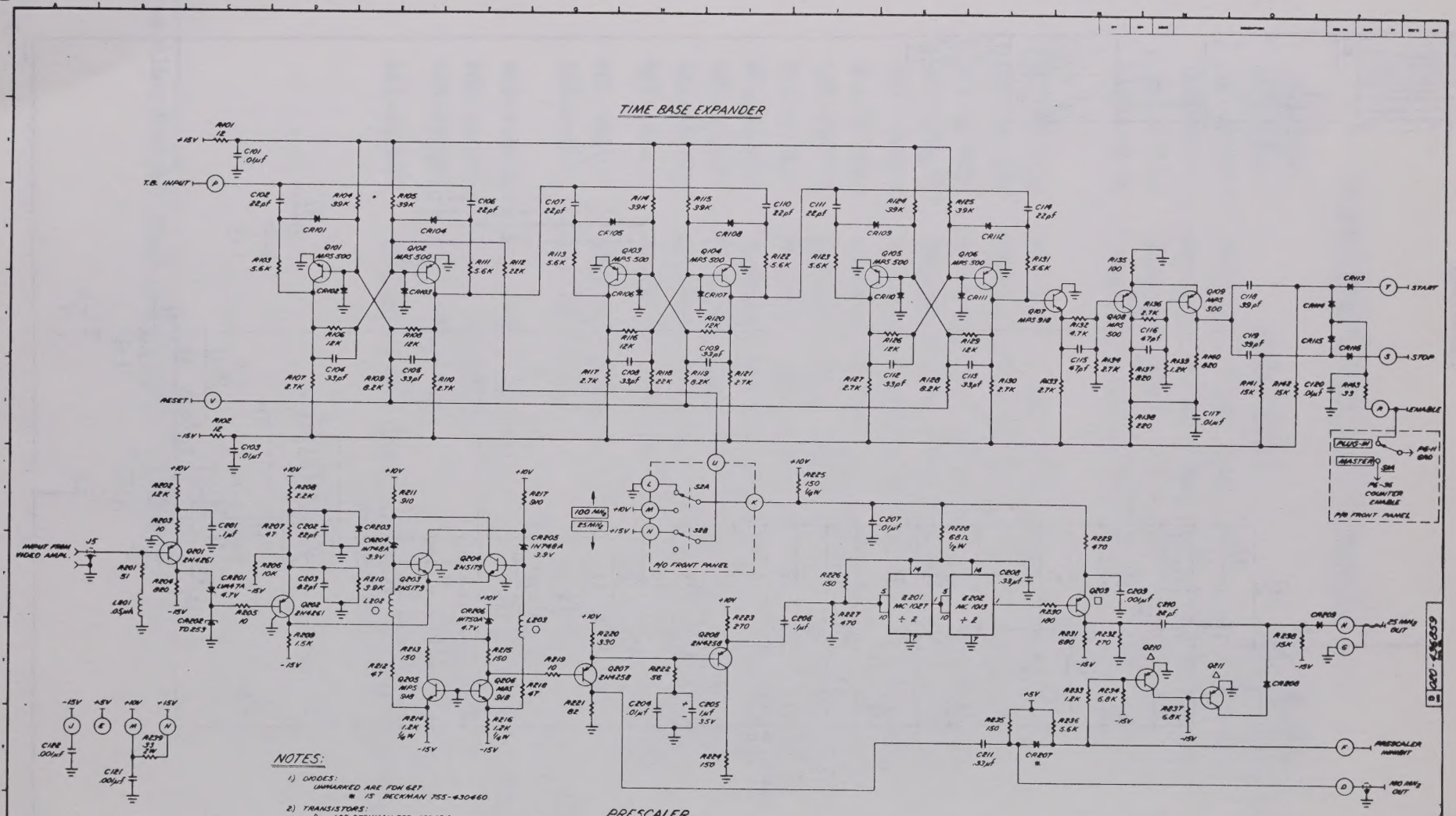
*"A. B." are Allen Bradley, fixed composition, resistors.

Master Board Parts List - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
R209	601-839642	Resistor, 1.5K, 1/8W, 5%	*A.B. BB1525	1
R210	601-839647	Resistor, 3.9K, 1/8W, 5%	A.B. BB3925	1
R211, 217	601-857508	Resistor, 910Ω, 1/8W, 5%	A.B. BB9115	2
R213, 215, 226, 235, 224	601-839630	Resistor, 150Ω, 1/8W, 5%	A.B. BB1515	5
R214, 216	601-822326	Resistor, 1.2K, 1/4W, 5%	A.B. CB1225	2
R220	601-839634	Resistor, 330Ω, 1/8W, 5%	A.B. BB3315	1
R221	601-839626	Resistor, 82Ω, 1/8W, 5%	A.B. BB8205	1
R222	601-839622	Resistor, 56Ω, 1/8W, 5%	A.B. BB5605	1
R223, 232	601-839633	Resistor, 270Ω, 1/8W, 5%	A.B. BB2715	2
R225	601-823391	Resistor, 150Ω, 1/4W, 5%	A.B. CB1515	1
R227, 229	601-839636	Resistor, 470Ω, 1/8W, 5%	A.B. BB4715	2
R228	601-015438	Resistor, 68Ω, 1/2W, 5%	A.B. EB6805	1
R230	601-839631	Resistor, 180Ω, 1/8W, 5%	A.B. BB1815	1
R231	601-839638	Resistor, 680Ω, 1/8W, 5%	A.B. BB6815	1
R234, 237	601-839650	Resistor, 6.8K, 1/8W, 5%	A.B. BB6825	2
R239	601-800117	Resistor, 33Ω, 2W, 5%	A.B. HB3305	1
Y1	881-550017	Crystal, 50 MHz	Beckman	1
XY1	132-809018	Crystal Clamp	Augat Bros. 6007-3CT	1
Z1	885-846633	I.C., Amp., LM201	Nat'l Semiconductor	1
Z201	885-435202	I.C., MC1027P	Beckman	1
Z202	885-435259	I.C., MC1013P	Beckman	1
	864-811098	Transistor Pad (used on Q9)	Milton Ross 10099	1

*"A.B." are Allen Bradley fixed composition, resistors.


200MHz GENERATOR
NOTES:
1) RESISTORS ARE ¼W 5%, UNLESS OTHERWISE NOTED.
2) ◯ – DENOTES EXTERNAL BOARD CONNECTIONS
3) FACTORY SELECTED VALUE, 33Ω TYP VALUE
4) C15 MECHMAN AT85-5100T/
SCHEMATIC MASTER BOARD
020-436859



NOTES:

1) DIODES:
UNMARKED ARE FDH 627.
* IS BECKMAN 755-430460.

2) TRANSISTORS:
△ - ARE BECKMAN 755-422494.
□ - " " 755-425735.

3) RESISTORS ARE ½W, 5% UNLESS OTHERWISE NOTED.

4) INDUCTORS:
○ - ARE SPECIAL WIRE INDUCTORS.

5) PINS 3,5,6,7,8,9,11 & 12 ON A201 & A202 ARE CONNECTED TO GND.